Table I. Preoperative characteristics

	All patients (*n* = 380)	*No workup* (*n* = 28)	*ECG only* (*n* = 127)	*Echo* (*n* = 208)	*Stress test* (*n* = 13)	*Coronary angiography* (*n* = 4)	P *value*
Age, years	64.3 ± 14.7	47.5 ± 16.5	63.6 ± 14.8	66.7 ± 13.1	66.4 ± 10.3	73.8 ± 11.5	<.01
Male sex	232 (61.1%)	15 (53.6%)	89 (70.1%)	118 (56.7%)	7 (53.9%)	3 (75.0%)	.12
Hypertension	329 (86.6%)	14 (50.0%)	114 (89.8%)	187 (89.9%)	10 (76.9%)	4 (100.0%)	<.01
Hyperlipidemia	220 (57.9%)	7 (25.0%)	76 (59.8%)	122 (58.7%)	11 (84.6%)	4 (100.0%)	<.01
Known CAD	109 (28.7%)	2 (7.1%)	39 (30.7%)	59 (28.4%)	6 (46.2%)	3 (75.0%)	.01
History of MI	46 (12.1%)	1 (3.6%)	10 (7.9%)	29 (13.9%)	5 (38.5%)	1 (25.0%)	<.01
Congestive heart failure	24 (6.3%)/entry>	0 (0.0%)	9 (7.1%)	13 (6.3%)	1 (7.7%)	1 (25.0%)	.35
Tobacco abuse	230 (60.5%)	10 (35.7%)	67 (52.8%)	140 (67.3%)	10 (76.9%)	3 (75.0%)	<.01
Diabetes	57 (15.0%)	2 (7.1%)	18 (14.2%)	33 (15.9%)	3 (23.1%)	1 (25.0%)	.64

ECG, Electrocardiogram; *CAD,* coronary artery disease; *MI,* myocardial infarction.

Table II. Procedural indications and procedures performed

	Procedure indication				*Procedure performed*			
	Aneurysm (*n* = 225)	*Dissection* (*n* = 127)	*Transection* (*n* = 28)	P *value*	*Descending only repair* (*n* = 288)	*Hybrid TAAA repair* (*n* = 65)	*Any arch involvement* (*n* = 27)	P *value*
No workup	7 (3.1%)	8 (6.3%)	13 (46.4%)	<.01	26 (9.0%)	1 (1.5%)	1 (3.7%)	<.01
ECG only	71 (31.6%)	44 (34.7%)	12 (42.9%)		107 (37.2%)	16 (24.6%)	4 (14.8%)	
Echo	131 (58.2%)	75 (59.1%)	2 (7.1%)		145 (50.4%)	42 (64.6%)	21 (77.8%)	
Stress test	12 (5.3%)	0 (0%)	1 (3.4%)		8 (2.3%)	5 (7.7%)	0 (0%)	
Coronary angiography	4 (1.8%)	0 (0%)	0 (0%)		2 (0.7%)	1 (1.5%)	1 (3.7%)	

ECG, Electrocardiogram; *TAAA*, thoracoabdominal aortic aneurysm.

Table III. Perioperative characteristics/outcomes

	All patients (*n* = 380)	*No workup* (*n* = 28)	*ECG only* (*n* = 127)	*Echo* (*n* = 208)	*Stress test* (*n* = 13)	*Coronary angiography* (*n* = 4)	P *value*
Ejection fraction	53.1 ± 4.8	54.4 ± 1.8	53.2 ± 3.9	53.1 ± 5.1	51.8 ± 5.1	52.5 ± 3.5	.84
ASA class =4	151 (39.7%)	21 (75.0%)	60 (47.2%)	61 (29.3%)	6 (46.2%)	3 (75.0%)	<.01
Nonelective procedure status	148 (39.0%)	24 (85.7%)	54 (42.5%)	66 (31.7%)	4 (30.8%)	0 (0.0%)	<.01
Concomitant procedure or vessel Bypass (eg, peripheral stent or vessel bypass)	156 (41.1%)	8 (28.6%)	45 (35.4%)	94 (60.3%)	7 (53.9%)	2 (50.0%)	.20
Outcomes							
30-day myocardial infarction	9 (2.4%)	0 (0%)	1 (0.8%)	8 (3.9%)	0 (0%)	0 (0%)	.35
30-day cardiac event (MI+ cardiac arrest)	9 (2.4%)	0 (0%)	1 (0.8%)	8 (3.9%)	0 (0%)	0 (0%)	.35
30-day cardiac specific mortality	3 (0.8%)	0 (0%)	1 (0.8%)	2 (1.0%)	0 (0%)	0 (0%)	.98
30-day mortality	21 (5.5%)	0 (0%)	9 (7.1%)	12 (5.6%)	0 (0%)	0 (0%)	.52

ECG, Electrocardiogram; *ASA*, American Society of Anesthesiologists; *MI*, myocardial infarction.

workup consisted of assessment of cardiac symptomatology along with resting ECG and/or TTE, with further workup indicated for unstable symptoms, significantly abnormal ECG or TTE, or multiple cardiac risk factors. Categorical and continuous variables were compared using the χ^2 test and analysis of variance, respectively.

Results: Baseline characteristics are presented in the Table I; n = 28 (7.4%) patients had no preoperative cardiac workup, n = 127 (33.4%) had resting ECG only, n = 208 (54.7%) had a resting echo, n = 13 (3.4%) underwent stress testing, and n = 4 (1.1%) had coronary angiography (only one required preoperative percutaneous intervention) for cardiac workup. Patients undergoing stress testing or coronary angiography were older and had a higher incidence of known coronary artery disease ($P <$ .01) and prior MI (P = .02). Significant differences were noted in procedural indications, procedure performed, patient ASA class, and procedure status (Tables II and III). A total of n = 9 (2.4%) patients experienced a perioperative cardiac event (MI and/or cardiac arrest), with no significant difference noted amongst all groups (P = .35), suggesting the extent of cardiac workup was appropriate. Incidence of 30-day/in-hospital and cardiac specific mortality was likewise similar amongst all groups (Table III).

Conclusions: Risk of a postoperative cardiac event following TEVAR is low (2.4%), and the data presented suggest that initial screening with either resting TTE or ECG, in addition to assessment of cardiac symptom status, is adequate in the vast majority of patients. As such, we recommend resting TTE and/or ECG as the initial cardiovascular screening mechanism in patients undergoing TEVAR, with subsequent more invasive studies if initial screening reveals cardiovascular abnormalities.

Retrograde Pedal Access for Patients with Critical Limb Ischemia: Feasibility and Outcomes over a Three-Year Period

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Objectives: Retrograde pedal access allows the treatment of tibial occlusive lesions when standard endovascular techniques fail. We aimed to analyze the outcomes in patients with chronic limb ischemia Rutherford class IV and V, who were otherwise not candidates for revascularization thru an antegrade access or tibial bypass.

Methods: Over a three-year period, a retrograde pedal access was selectively chosen when a popliteal or tibial lesion could not be crossed via an antegrade approach. Retrograde pedal access was performed under ultrasound-guidance using a 4-Fr micropuncture co-axial sheath. All interventions were performed in a sheathless fashion using a 0.014" or 0.018" 'bareback' wire as support for a 2 or 2.5 mm balloon catheter to cross and treat tibial chronic total occlusions that could not be treated via an

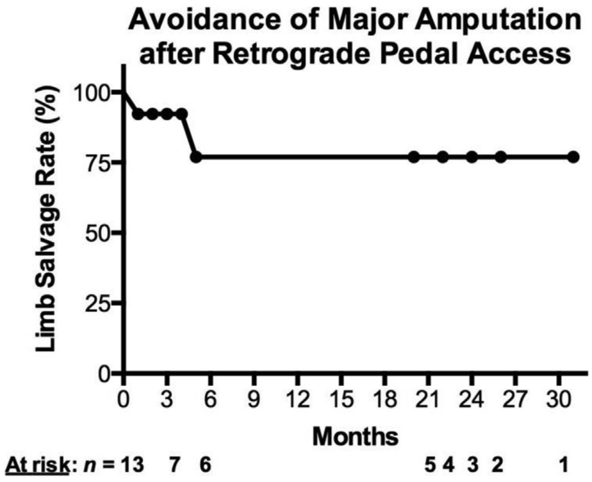

Fig.

antegrade approach. Routine anticoagulation and dual-antiplatelet therapy was used peri-procedurally. Antegrade access was used to treat any lesion that required a stent placement, after the retrograde wire was snared and brought through the antegrade guide catheter. Patient indications and comorbidities were recorded; outcomes analyzed were limb salvage rate, peri-procedural complications and mortality. Mean and standard deviations were calculated; Kaplan-Meier was used to calculate limb salvage rates.

Results: A review all lower extremity interventional angiograms from July 2010 thru August 2013 (n = 764) identified 13 cases in which a retrograde pedal access was performed (mean age was 71.4 ± 12.4 years, 9 men). There was high prevalence of diabetes (77%; 10/13), chronic renal insufficiency (stages III - V; 69%, 9/13), and previous contralateral major amputation (38%; 5/13). Indications for a retrograde pedal revascularization were Rutherford chronic limb ischemia class IV (15%; 2/13) and class V (85%; 11/13). Technical success rate was 69% (9/13); a variety of popliteal (2/13) and tibial (13/13) vessels were intervened with angioplasty alone (10/13) via a retrograde approach and with angioplasty/stent placement (3/13). The technical failures were due to inability to cross the occlusion(s). Periprocedurally, there was one myocardial infarction, no local complications, worsening renal insufficiency or deaths. At a mean follow-up of 13.4 ± 10.3 months, the limb salvage rate was 77% (10/13) (Fig). There was a high mortality rate on follow-up in this cohort (23%; 3/13) occurring at median 6 ± 4 months.

Conclusions: Retrograde pedal access for limb salvage in high-risk patients is feasible and safe with acceptable limb salvage rates at intermediate follow-up. Appropriate candidates are those who have failed an antegrade intervention and are poor candidates for a tibial bypass. Future studies should test whether this mode of revascularization has favorable limb salvage rates in larger patient populations.

The Incidence and Outcome of DVT After Endovenous Laser Ablation

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Objectives: Endovenous ablation of the saphenous vein (EVLT) has become the preferred treatment for treating saphenous reflux, which results in symptomatic lower extremity venous insufficiency or varicose veins. This office-based ambulatory procedure was noted during initial Food and Drug Administration trials to have a low incidence of postoperative deep vein thrombosis (DVT). Later clinical experience suggested that the actual incidence of DVT may be much higher.

Methods: We reviewed the office records and the pre- and post-treatment ultrasounds of patients undergoing EVLT in our office from 2005 to 2010 to determine the frequency of postoperative DVT in patients we had treated and then graded them according to a previously published classification.

Results: There were 528 veins treated in 192 males and 336 females. The CEAP class for these patients was 1 (0), 2 (291), 3 (65), 4 (104), 5 (26), and 6 (40). The greater saphenous vein was treated in 496, the lesser saphenous vein (LSV) in 22 and both were treated in 10. DVT occurred in 27 of legs treated for an incidence of 5.1%. The DVTs in the femoral vein were of level 3 (3), 4 (7), 5 (12), and 6 (3). Two patients developed DVT in the popliteal vein after EVLT of the LSV. Treatment for the postop DVT consisted of observation (13), anticoagulation (9), antiplatelet therapy (2), and nonsteroidal anti-inflammatory agents (1). Duration of therapy was usually 1 week but seven patients were treated for periods ranging from 1 to 7 weeks. No pulmonary emboli occurred in any of these patients. The DVTs resolved completely in all patients.

Conclusions: The incidence of DVT after EVLT is higher than previously reported but is not associated with pulmonary embolism and mainly consists of low risk level 3, 4, and 5 DVT. The DVT typically resolves after 1 week and can be treated with a short course of antiplatelet or anticoagulation therapy although observation appears to be sufficient as well.

Thoracic Endovascular Aortic Repair for Intramural Hematoma: Safe and Effective Treatment Promoting Aortic Remodeling

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Objectives: Intramural hematoma (IMH), penetrating aortic ulcer (PAU), and aortic dissection comprise a spectrum of acute aortic pathologies. While thoracic endovascular aortic repair (TEVAR) has increasingly been applied to aortic dissection, there is a paucity of data on the impact of TEVAR for IMH on aortic anatomy. Our goal was to investigate the extent of aortic remodeling after TEVAR for IMH.

Methods: A retrospective chart review of patients from 2004 to 2012 was conducted on patients with IMH with or without PAU. Charts were reviewed in a retrospective manner to collect data detailing: demographics, indications for surgery, operative notes, and office progress notes. Radiology images were reviewed and primary data points included indices of the aortic true lumen (TL) and total aortic diameter at site of pathology (TAD). Aortic remodeling was evidenced by a TAD/TL ratio closest to 1.0. Patients with no preoperative computed tomography (CT) scan, or no imaging after 30 days of operation were not included for imaging analysis.

Results: During our 8-year period, 216 endovascular thoracic aortic repairs were reviewed. Forty-eight patients were found to have an IMH on presentation for repair; 25 of the 48 patients had an IMH with concomitant PAU. Of the total cohort, 18 were male with a mean age of 70.2 years ± 10 (standard deviation).Forty-six (96%) of patients had diagnoses of hypertension, 34 (71%) were smokers, and 7 (19%) had coronary artery disease or prior myocardial infarction. Indications for operation included intractable pain in 34 (69%), uncontrolled hypertension in six (13%) and rupture in eight (17%). Technically successful TEVAR was performed in all patients with 45 (94%) reporting relief of symptoms post procedure. Adjunctive procedures were performed in 19 (40%): 7 (14%) arch debranching, 6 (12%) laser fenestration, and 6 (12%) iliac conduit. Post procedurally, the 30 day mortality rate was 6% with a 4% rate of permanent paraplegia. At a mean follow-up of 11.6 months, the overall survival was 69% with a reintervention rate of 12%. For our imaging analysis, 12 patients were excluded due to lack of follow-up imaging after 30 days resulting in the analysis of 36 CT scans. Imaging revealed that the preoperative ratio of TAD/TL was 1.33 ± 0.13. The mean number of days to follow-up CT was 383 days with a range of 48 to 1486 days. There was a significant decrease in the postoperative TAD/TL ratio to 1.10 ± 0.10 (vs preoperative TAD/TL ratio; $P < .001$). 3 (8%) patients had subsequent repeat TEVAR procedure either due to proximal endoleak or graft migration. The mean change in TAD/TL ratio from pre to postoperative for the reinterventions was 0.14, while the mean change in TAD/TL ratio from pre to postoperative for the nonreinterventions was 0.27 ($P < .001$).

Conclusions: Although more longitudinal studies are necessary, endograft therapies for IMH, when anatomically possible, promote aortic remodeling, and potentially, complete long-term resolution.

The Impact of Congestive Heart Failure on the Acute Postoperative Outcomes in Patients Undergoing Lower Extremity Revascularization

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Objectives: As the management of peripheral vascular disease (PVD) evolves, it is important that we determine what factors affect the outcome of lower extremity interventions. The presence of PVD is associated with a twofold increase in the prevalence of congestive heart failure (CHF), and it is well known that patients with CHF are at risk for perioperative complications. It was recently demonstrated that CHF is associated with reduced patency after endovascular intervention for PVD at 1 year. However, the impact of CHF on patients undergoing infrainguinal bypass for PVD has not been extensively studied. The goal of this study is to